Applications of micro- and nanomechanical methods for characterization of hardness, elastic modulus and adhesion of Li-ion electrode coatings

Virgile Favre, Issa Thévenaz, Jiri Nohava*
jiri.nohava@anton-paar.com

Anton Paar TriTec SA, Corcelle

Abstract

Keywords: mechanical characterization, Li-ion battery, electrode, adhesion, hardness, elastic modulus

Lithium-ion batteries are currently under extensive research due to their implementation in electric vehicles. Their development and production however still require improvement in order to increase the capacity and lifetime of the batteries. While their electrical properties are generally well understood, their mechanical properties are often overlooked. They are however linked to the electrical performance of the battery and they often reflect changes in the production processes. The electrode structure, as one of the main components of the battery, undergoes severe mechanical loadings during production and it must therefore have sufficient mechanical strength. In our work we focused on the measurement of adhesion of electrode coatings and we will show the results of a new method for adhesion measurement of these layers. This method is basically a scratch test but instead of a spherical indenter it uses a wedge blade indenter. The results obtained with the new indenter provide much more reliable and easy-to-analyze results than with the traditional setup. Further, we will show how nanoindentation can be used for estimation of the distribution of hardness and elastic modulus in the electrode layer to document its mechanical homogeneity. Finally, the nano- and micromechanical devices can also be used for measuring the compression resistance of particles that are the core part of the slurry deposited on the cathode. The presented methods should contribute to the development of Li-ion electrodes for improving adhesion and mechanical resistance, resulting in longer lifetime.